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ABSTRACT

This teaching unit is designed to help students in grades 5 to 8 explore the concepts of measurement, ratios, and graphing in the context of designing a dragster. The units in the series have been developed to enhance and enrich mathematics, science, and technology education and to accommodate different teaching and learning styles. Each unit consists of background notes for the teacher, a list of teacher resources, and two activities, one of which is Web-based, complete with blackline masters. Also included are suggestions for extensions to the problems and their relationships to national mathematics, science, and technology standards. In this activity, students work in groups to construct a dragster and propulsion system using common household supplies. (MM)

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NASA CONNECT

Program 1 in the 2000-2001 Series

NASA

ED 458 130

Measurement, Ratios, and Graphing:

3...2...1...Crash!

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SE005301

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PROGRAM OVERVIEW

SUMMARY AND OBJECTIVES

In *Measurement, Ratios, and Graphing: 3...2...1...Crash!*, students will learn the history of the National Aeronautics and Space Administration (NASA) and discover how NASA Langley Research Center improves aircraft performance and safety by conducting extreme tests such as crashing planes, skidding tires, and blasting water. Students will observe NASA engineers using measurement, ratios, and graphing to make predictions and draw conclusions during their extreme tests. Students will learn how NASA researchers (1) measure and collect data, (2) develop ratios and graphs to analyze their data, (3) compare their results, and (4) predict possible solutions for their real-world problems.

INTERACTIVE ACTIVITIES

To direct the instruction, questions are posed throughout the video by Norbert, the animated co-host of NASA CONNECT. Students are encouraged to think about answers to the questions and write their answers on the Student Cue Cards provided (p. 9). By answering the cue card questions, students will make the connection between the research conducted at NASA and the mathematics, science, and technology they learn in their classroom.

The hands-on classroom activity (p. 2), entitled the Effervescent Noncombustible Dragster (ENCD), is teacher-created and aligned with the national mathematics, science, and technology standards. Students will construct and test their own dragster, measure and collect data, and analyze the results just like NASA researchers.

ED.U.Tour, the on-line activity, (p. 10) allows students to tour the Aircraft Landing Dynamics Facility (ALDF) at NASA Langley Research Center. Interactive activities acquaint students with various mathematics and science concepts related to the research mission of the ALDF. ED.U.Tour is located in Norbert's lab at **http://connect.larc.nasa.gov/crash/lab.html**

RESOURCES

Teacher and student resources (p.11) support, enhance, and extend the NASA CONNECT program. Books, periodicals, pamphlets, videotapes, and web sites provide teachers and students with background information and extensions. In addition to the resources listed in this lesson guide, the NASA CONNECT web site **(http://connect.larc.nasa.gov)** offers on-line resources for teachers, students, and parents. Teachers who would like to get the most from the NASA CONNECT web site can connect to Norbert's Lab and receive assistance from our "Lab Manager."

THE CLASSROOM ACTIVITY

BACKGROUND

The Effervescent Noncombustible Dragster (ENCD) activity is designed to visually simulate the research done at the NASA Langley Research Center's Aircraft Landing Dynamics Facility (ALDF). ALDF uses a high-pressure water-jet system to propel a test carriage along a track to test aircraft landing gear and runway surfaces. Background information on the statistics of ALDF can be obtained from the web site **http://sdb-www.larc.nasa.gov/SDB/ALDF.html.**

Students work in groups to construct a dragster and propulsion system using common household supplies. The objective of the activity is to examine various ratios of the propulsion mixture that result in the greatest distance the dragster travels. Through experimenting and predicting, students use measurement, ratios, and graphing to test their findings.

NATIONAL STANDARDS

MATHEMATICS STANDARDS

- Understand patterns, relations, and functions.
- Represent and analyze mathematical situations and structures using algebraic symbols.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.
- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.
- Select and use appropriate statistical methods to analyze data.
- Develop and evaluate inferences and predictions that are based on data.
- Apply and adapt a variety of appropriate strategies to solve problems.
- Solve problems that arise in mathematics and in other contexts.
- Monitor and reflect on the process of mathematical problem solving.
- Recognize reasoning and proof as fundamental aspects of mathematics.
- Make and investigate mathematical conjectures.
- Develop and evaluate mathematical arguments and proofs.
- Communicate mathematical thinking coherently and clearly to peers, teachers, and others.
- Use the language of mathematical ideas precisely.
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- Create and use representations to organize, record, and communicate mathematical ideas.
- Use representations to model and interpret physical, social, and mathematical phenomena.

SCIENCE STANDARDS

- Scientific inquiry
- Properties and changes of properties in matter
- Motion and forces
- Transfer of energy
- Abilities of technological design
- Understanding about science and technology

TECHNOLOGY STANDARDS

- Use technology tools to enhance learning, increase productivity, and promote creativity.
- Use technology tools to locate, evaluate, and collect information from a variety of sources.
- Use technology tools to process data and report results.

INSTRUCTIONAL OBJECTIVES

Students will be able to

- construct an ENCD, a propulsion device, and test track using metric measurement.
- use measurement and ratios to perform experiments and predict outcomes of their trials.
- use graphing to organize their data, interpret, and analyze their results.

VOCABULARY

Axle – a bar connected to the center of a circular object such as a wheel that allows or causes it to turn, especially one connecting two wheels of a vehicle.
Circumference – distance around a circle
Propel – to drive forward or onward by means of a force that causes motion
Effervesce – producing bubbles of gas in a liquid
Noncombustible – not capable of igniting and burning

PREPARING FOR THE ACTIVITY

MATERIALS

DRAGSTER

6 –8 oz **foam cup**
foam **meat tray** (approx. 9 cm long and 7 cm wide)
ballpoint **pen**
tape – a type that will stick to foam cups (duct tape works well)
3 **straws** – standard length
2 **wooden skewers**
4 round **film canister tops** or plastic milk carton tops

PROPULSION DEVICE

shoe box – bottom portion
scissors
1 **wooden skewer**
Velcro® – 5 cm long, 3 cm wide (adhesive back)
film canister – clear plastic with a lid that snaps inside the canister instead of outside the canister

TEST TRACK

masking tape
meter stick
marker

MATERIALS TO RUN THE TEST

effervescent antacid tablets
graduated cylinder
paper towels
water – room temperature for the mixture and additional water to rinse the canister after each use
safety glasses for students preparing the propulsion mixture

TIME

Construction of dragster and propulsion device . . . . . 45 min
Preparation of test track and running the experiment . . . . . 45 min
Graphing and analyzing data . . . . . 45 min

ADVANCE PREPARATION

The film canister tops (milk carton tops) require a small pilot hole for the wooden skewer. The teacher should prepare these in advance for all groups. Use a small nail or sharp pen to puncture the center of the film canister or milk carton top. Test the hole to be sure that the top will fit securely onto the skewer. If the top turns freely on the skewer, the hole is too big.

Depending on the students, the teacher may choose to prepare the effervescent tablets in appropriate fractional sizes. Use the point of a sharp ink pen to score the top of the tablet by scratching a bisecting line across it. Break the tablet in half. Use the same process to create fourths by bisecting the half sections. The students will start the experiment with a half tablet, then through predicting, students will choose other fractional parts. It is recommended that you provide each group with at least a half tablet, 1 whole tablet, and 4 quarter sections. If you prepare the sections in advance, be sure to seal them tightly in a moisture proof container so they will not lose the effervescence prior to the experiment.

Optional: The teacher may choose to mark the exterior of the film canisters to indicate the 10 mL measure. Scratch the surface of the film canister or place tape at the appropriate location for 10 mL of water, thus enabling the students to pour the water directly into the canister without using the graduated cylinder during each trial.

Students may choose to decorate the constructed dragster.

CAUTION

The combination of the effervescent tablet and water creates a reaction that pops the top off the film canister. The time it takes for the top to pop can be as little as 5 seconds and as long as 16 seconds. Remind students to follow the directions: fill the film canister with 10 mL of water and bend next to the shoe box with the film canister. While holding the canister near the Velcro® on the shoe box, drop the effervescent tablet into the water and **very quickly** snap the top on tightly and attach the canister to the Velcro® on the shoe box. Step away from the propulsion device.

Students should wear safety glasses when preparing the mixture and film canister. Be prepared to clean up water and tablet residue that spills onto the floor upon blast off. Rinse the canister after each use to remove remaining residue.

THE ACTIVITY

STEP 1: CONSTRUCT THE DRAGSTER

A. BACK OF THE DRAGSTER

1. Place the open end of the foam cup on a foam meat tray. Trace the circumference of the cup onto the foam meat tray and cut out the circle.
2. Tape the foam circle to the open end of the cup.

B. WHEEL BASE

1. Cut a straw 7cm long and tape the straw to the rim on the front end of the dragster (see figure 1).
2. Cut a second straw 13 cm long and tape the straw to the bottom of the back end of the cup so that the straws are parallel to each other and close to the rim at each end (see figure 2).
3. Thread a skewer through each straw and break off or cut the ends so that 2 to 3 cm of the skewer extend beyond the straw on each side.
4. Push a cap wheel onto the skewer on each side of the straw. Leave a small gap between each wheel and straw so the wheels are able to roll.
5. Tape a straw to the bottom of the cup, perpendicular to the other two straws (wheel axles). The straw should extend about 4 cm beyond the rear wheel axle (see figure 3).

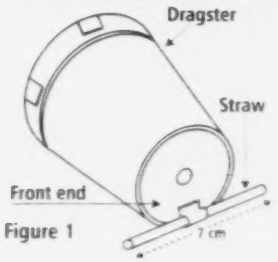


Figure 1

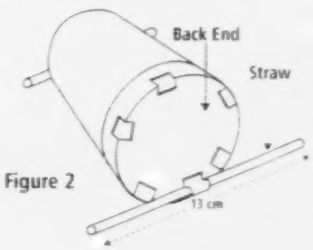


Figure 2

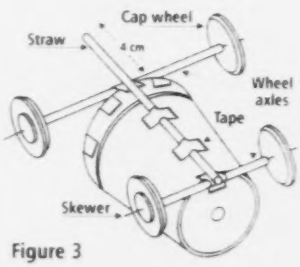


Figure 3

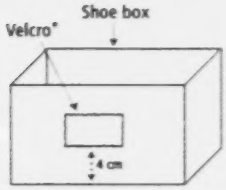


Figure 4

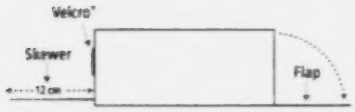


Figure 5

STEP 2: CONSTRUCT THE PROPULSION DEVICE

1. Mark an "X" in the center of the end of the shoe box.
2. Glue a 5-cm section of Velcro® to the location of the "X" approximately 4 cm from the bottom of the shoe box (see figure 4).
3. Glue the opposing side of the Velcro® to the bottom of the film canister; trim as needed.
4. Cut the back seams of the shoe box, opposite the end where the Velcro® has been attached. Pull down the flap, created by cutting the seams, so that it is level with the bottom of the box.
5. Poke a skewer through the front end of the shoe box close to the bottom of the box and centered directly beneath the Velcro® strip. Extend the skewer through the hole 12 cm beyond the edge of the front of the box (see figure 5).

STEP 3: PREPARE TEST TRACK

1. Cut two pieces of masking tape: one piece for the starting line (1 m long) and a second piece (5 m long) to measure the distance the dragster travels.
2. Place the masking tape at a right angle on the floor.
3. Mark the longest piece of tape in increments of decimeters (dm).

STEP 4: TRIALS

A. FIRST RATIO

1. Ratio of 1/2 of an effervescent tablet to 10 mL (approximately 2 tsp) water
2. Begin the trial by placing the dragster behind the starting line.
3. Align the shoe box behind the dragster. Slide the skewer, which is on the box, into the straw on the bottom of the dragster.
4. Adjust the dragster and shoe box behind the starting line so that the wheels of the dragster align with "zero" on the marked tape.
5. Place your foot into the shoe box to hold it in place during the test. Adjust the box and dragster as needed, so that the front wheels remain aligned with "zero" (see figure 6).
6. **Put on safety goggles.** Fill the film canister with 10 mL water and hold it near the front of the shoe box.
7. Drop the effervescent tablet into the canister and snap on the canister cap.
8. Quickly attach the canister to the Velcro® on the shoe box.
9. Position the dragster to rest against the film canister. **Stand back during blastoff.**
10. After the dragster has stopped, place a ruler or straightedge perpendicular to the marked tape and next to the front wheels of the dragster.
11. Record the distance traveled on the Student Data Sheet (p. 8) for the ratio tested.
12. Rinse the canister with clean water and dry with a paper towel.
13. Repeat the trial using the same ratio.
14. Record the distance traveled.
15. Determine the average distance traveled of the two trials and enter your answer in the last column of the Student Data Sheet (p. 8).
16. Rinse and dry the canister to remove previous trial residue.

Figure 6

B. SECOND RATIO

1. Predict a ratio of effervescent tablet to water that might yield a greater distance.
2. Follow the processes in Step 4-13, part A (p. 6) using your predicted ratio.
3. Record your findings on the Student Data Sheet (p. 8).
4. Determine the average of your two trials and record the answer on the Student Data Sheet (p. 8).
5. Rinse and dry the canister.

C. THIRD RATIO

1. Based on the findings of the previous trials, predict another ratio that might yield the greatest distance.
2. Follow the process in Step 4-13, part A (p. 6), using the second predicted ratio.
3. Record your findings on the Student Data Sheet (p. 8).
4. Determine the average of your two trials and record the answer on the Student Data Sheet (p. 8).

STEP 5: GRAPH THE RESULTS

DISCUSS THE CONSTRUCTION OF THE GRAPH

1. What are the independent and dependent variables?
2. What increments of measure should be used?
3. Construct the graph and plot the points.
4. Construct one graph for the entire class either on the chalkboard, the overhead, or on a large piece of paper taped to the wall.
5. Have each group plot its average distances for each ratio tested on the class graph. (Each group should plot at least three points. Use a different color for each group.)

STEP 6: ANALYZE THE DATA

A. DISCUSS THE GRAPH OF THE RESULTS

1. What type graph was constructed? (scatter, line, bar?)
2. Are there different distance values plotted for the same ratio? Why?
3. Are there values that lie outside the groups of points? Why?

B. MAKE PREDICTIONS

1. Based on the recorded data, what ratio produced the greatest distance?
2. What process would you use to find the maximum value of the distance? Is it possible to find the maximum value based on this experiment?
3. Test the predictions.
4. Discuss the outcomes.

EXTENSIONS

1. Construct the dragster from a soda can or plastic water or soda bottle (1/2 to 2L) and use vinegar and baking soda as a propulsion mixture. As before, change the ratio for optimum performance. Begin with the ratio of 200 mL vinegar to 16 g baking soda.
2. Construct an ENCD that is more aerodynamic by adding parts to the front, sides, and back. Compare the test results with the original dragster.
3. Analyze the graph of your test results. Do the results model a particular algebraic function; for example, parabolic, exponential, or linear? How can you test your hypothesis?

STUDENT DATA SHEET

RATIO	DISTANCE 1	DISTANCE 2	AVERAGE DISTANCE

WORK AREA:

STUDENT CUE CARDS

Bob Daugherty, NASA Langley Research Center, Aircraft Landing Dynamics Facility

1. How is the test set up to solve the problem? _____

2. How are graphs used to find possible solutions? _____

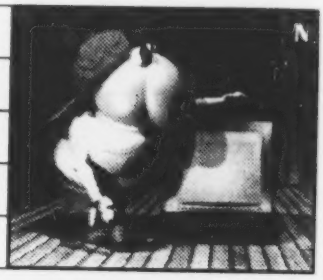
3. What visual method did NASA engineers use to represent their solution? _____

Lisa Jones, NASA Langley Research Center, Impact Dynamics Research Facility

How is technology used to collect the mathematical data in crash tests? _____

Why is area important in the results of the test? _____

How are ratios used to find a solution? _____

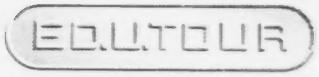


THE WEB ACTIVITY

PREPARING FOR THE ACTIVITY

BACKGROUND

ED.U.Tour is a web-based tour of the Aircraft Landing Dynamics Facility (ALDF) at NASA Langley Research Center and includes activities that acquaint students with various mathematics and science concepts related to the research mission of the ALDF. For each of the four parts of the lab: Propulsion, Carriage, Track, Arrestment, there is a corresponding interactive lesson that presents some of the key science and mathematics principles associated with the ALDF system.



To access ED.U.Tour, visit Norbert's lab
http://connect.larc.nasa.gov/crash/norbert/lab.html

From Norbert's lab, there is also a link to Career Corner featuring researchers and NASA CONNECT team members talking about their jobs at NASA and links to additional on-line resources. New this season is a section in the lab for teachers. The NASA CONNECT "Lab Manager" offers assistance to teachers who would like to get the most from the site.

NATIONAL STANDARDS

TECHNOLOGY STANDARDS

- Use technology tools to enhance learning, increase productivity, and promote creativity.

SCIENCE STANDARDS

- Motion and forces
- Properties of objects and materials
- Motions and forces
- Abilities of technological design

MATHEMATICS STANDARDS

- Understand patterns, relations, and functions.
- Use mathematical models to represent and understand quantitative relationships.
- Analyze change in various contexts.
- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.
- Develop and evaluate inferences and predictions that are based on data.
- Create and use representations to organize, record, and communicate mathematical ideas.
- Use representations to model and interpret physical, social, and mathematical phenomena.

INSTRUCTIONAL OBJECTIVES

- Students will be able to calculate distance traveled, given visual representations, and relate their findings to NASA research.
- Students will be able to determine ratios, given visual representations, and predict outcomes based on their findings.

RESOURCES

BOOKS, PAMPLETS, VIDEOTAPES AND PERIODICALS

NASA Facts: *Exploring NASA's Roots: The History of Langley Research Center,* NF167 April 1992

Davis, Stubbs, and Tanner: *Langley Aircraft Landing Dynamics Facility,* NASA RP-1189, October 1987

Buck, Rinder: *Flight of Passage: A Memoir,* Hyperion, June 1998 Reprint Edition

Bilstein, Roger E.: *Orders of Magnitude: A History of the NACA and NASA, 1915-1990 (NASA SP-4406)* 1989

Krause, Shari Stamford: *Aircraft Safety: Accident Investigations, Analyses, and Applications.* McGraw-Hill Companies, February 1996.

Rosenberg, Barry: Airbags for Aircraft, *Popular Mechanics,* 1/97, Volume 174, p. 60.

Skidding to Disaster, *Time,* 6/14/99, Volume 153, p. 58.

The Drop Test, *World of Wonder,* GRB Entertainment, Show 403 (Call 1-818-728-7600 for video information)

WEB SITES

NASA's homepage with links for students **http://www.nasa.gov/**

NASA Langley Research Center's homepage **http://www.larc.nasa.gov**

NASA Langley's Structural and Dynamics Branch homepage with links to the Aircraft Landing and Dynamics Facility (ALDF) and the Impact Dynamics Research Facility (IDRF) **http://SDB-www.larc.nasa.gov/SDB/SDB.html**

Overview of NASA Langley's Impact Dynamics Landing Facility (IDRF)
http://oea.larc.nasa.gov/tour/impact1.html

Overview of NASA Langley's Aircraft Landing Dynamics Facility (ALDF)
http://oea.larc.nasa.gov/tour/ALDF1.html

National Highway Traffic Safety Administration homepage
http://www.nhtsa.dot.gov/

Description of how the shuttle lands at Kennedy Space Center
http://www-pao.ksc.nasa.gov/kscpao/nasafact/landing.htm

An article about NASA Langley's IDRF
http://www.knowledgerevolution.com/press/stories/ss_nasa.html

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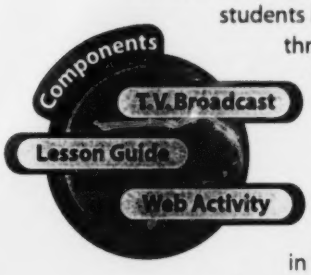
2001-2002 Series Overview

INTRODUCTION TO THE NASA CONNECT SERIES

What is NASA CONNECT?

NASA CONNECT is an annual series of FREE integrated mathematics, science, and technology instructional distance learning programs for students in grades 5-8. Each program has three components: (1) a 30-minute television broadcast, which can be viewed live or taped for later use (see right); (2) an interactive web activity which provides educators an opportunity to use technology in the classroom setting; and (3) a lesson guide describing a hands-on activity. These three components — television broadcast, web activity, and lesson guide — are designed as an integrated instructional package.



NASA CONNECT is FREE to educators. Register on our web site, **http://connect.larc.nasa.gov**. Registered educators will receive, via E-mail, the date of upcoming shows, a show summary, and a PDF version of the lesson guide. NASA CONNECT is a U.S. Government product and is not subject to copyright. There are no fees or licensing agreements. Broadcast and off air rights are unlimited and granted in perpetuity.

Endorsed by the National Council of Teachers of Mathematics (NCTM), NASA CONNECT supports national mathematics, science, and technology standards. The 2001-2002 series uses proportional reasoning as the "integrative thread" that "connects" mathematics topics in each program. NASA CONNECT seeks to establish a "connection" between the mathematics, science, and technology concepts taught in the classroom and the mathematics, science, and technology used everyday by NASA researchers. By demonstrating the processes of creativity, critical thinking, and problem solving skills, NASA CONNECT enhances and enriches mathematics, science, and technology education.

How can I get the television broadcast?

- The shows are broadcast on Ku- and C-band satellite and can be downlinked using the satellite coordinates listed on the NASA CONNECT web site, **http://connect.larc.nasa.gov**.
- NASA CONNECT shows are carried by over 130 PBS stations, Channel One, and on many Cable Access Channels. Check our web site for viewing in your locality.
- Shows are available on the web through NASA's Learning Technologies Channel, **http://quest.arc.nasa.gov/ltc/special/connect/index.html**.
- Video copies of the broadcast can be obtained from the NASA Educator Resource Center in your state, **http://education.nasa.gov/ercn** (p. 8),or from the NASA Central Operation of Resources for Educators, **http://core.nasa.gov** (p. 7).

Educator Services

Get a classroom mentor.

The American Institute of Aeronautics and Astronautics (AIAA) provides classroom mentors to assist educators with the hands-on activities. Every effort will be made to match an educator with an AIAA member who will assist the educators either in person or by E-mail. To request a mentor, e-mail **nasaconnect@aiaa.org** or call Lisa Bacon at (703) 264-7527 at least four weeks prior to conducting the student activity.

Free e-mail account

If you do not currently have an e-mail account, free accounts are available for educators at ePALS Classroom Exchange. Simply visit **www.epals.com** and click on "Step 1: Join our online community" to register. Registration takes only two minutes and allows you to access E-mail tools and to create a searchable profile for your class. Include the term "NASA CONNECT" or "AIAA Mentor" in your profile description and you will be able to find and communicate with colleagues also using the NASA CONNECT program.

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NASA CONNECT 2001-2002 Theme

The 2001-2002 NASA CONNECT series uses the five Strategic Enterprises as its organizing theme: Aerospace Technology, Earth Science, Human Exploration and Development of Space, Space Science, and Biological and Physical Research. For more information on these Enterprises visit **http://www.nasa.gov/enterprises.html**. This theme forms the creative basis for the series of nine programs; four new programs and five repeat programs from the 2000-2001 NASA CONNECT series.

2001-2002 NASA CONNECT PROGRAMS

MEASUREMENT, RATIOS, AND GRAPHING: Safety First

Starts airing: Thursday, September 27, 2001, 11 am ET

NASA engineers and researchers use measurement, ratios, and graphing to maintain high levels of aviation safety and to develop new technologies to meet the growing demands — keeping you safe in tomorrow's skies.

Mathematics: measurement, ratios, graphing

Science: unifying concepts and processes, science as inquiry, science and technology, science in personal and social perspectives

NASA Research: Aviation Safety, Virtual Flight Tower

MEASUREMENT, RATIOS, AND GRAPHING: 3, 2, 1.... Crash! (R)*

Starts airing: Thursday, October 25, 2001, 11 am ET

Crashing planes, skidding tires, and blasting water, NASA engineers work to improve airplane performance and safety.

Mathematics: measurement, ratios, graphing

Science: science and technology, science as inquiry, physical science

NASA Research: Aircraft Landing Dynamics Facility, Impact Dynamics Research Facility

GEOMETRY AND ALGEBRA: The Future Flight Equation

Starts airing: Thursday, November 29, 2001, 11 am ET

NASA engineers and researchers use geometry and algebra to design, develop, and test tomorrow's aircraft.

Mathematics: geometry, algebra

Science: science as inquiry, unifying concepts and processes, science and technology

NASA Research: Advanced Vehicle Concepts, Hyper X

GEOMETRY AND ALGEBRA: Glow with the Flow (R)*

Starts airing: Thursday, December 13, 2001, 11 am ET

NASA aerospace engineers use scale models to see how air flows and why materials glow under wind tunnel conditions.

Mathematics: geometry and algebra

Science: physical science, science and technology, science in personal and social perspectives, science as inquiry

NASA Research: Flow Visualization, Blended Wing Body

DATA ANALYSIS AND MEASUREMENT: Ahead, Above the Clouds (R)*

Starts airing: Thursday, January 31, 2002, 11am ET

Predicting severe weather, tracking clouds, and monitoring pollutants in the air, NASA engineers and scientists are developing technologies to collect data that will help them better understand Earth's climate.

Mathematics: data analysis and measurement

Science: Earth and space science, physical science, science as inquiry, science and technology, science in personal and social perspectives

NASA Research: Geostationary Imaging Fourier Transform Spectrometer (GIFTS)

PATTERNS, FUNCTIONS AND ALGEBRA: Wired for Space (R)*

Starts airing: Thursday, February 28, 2002, 11am ET

NASA researchers develop new ways to propel a spacecraft already in orbit without the aid of fuel.

Mathematics: patterns, functions, algebra

Science: physical science, Earth and space science, science as inquiry

NASA Research: Propulsive Small Expendable Deployer System (ProSEDS)

***(R) indicates a repeat show from the 2000-2001 series**

DATA ANALYSIS AND MEASUREMENT: Having a Solar Blast

Starts airing: Thursday, March 28, 2002, 11 am ET

NASA engineers and researchers use data analysis and measurement to predict solar storms, anticipate how they will affect the Earth, and improve our understanding of the Sun-Earth system.

Mathematics: data analysis, measurement

Science: science as inquiry, unifying concepts and processes, physical science, Earth and space science, science and technology, science in personal and social perspectives

NASA Research: SOlar Heliospheric Observatory (SOHO), Imager for Magnetopause-to-Aurora Global Exploration (IMAGE)

FUNCTIONS AND STATISTICS: International Space Station: Up to Us (R)*

Starts airing: Thursday, April 25, 2002, 11 am ET

Ground research + space research = true science as international researchers anticipate working together onboard the International Space Station.

Mathematics: functions, statistics

Science: science and technology, Earth and space science, physical science, science as inquiry

NASA Research: International Space Station Program, Virtual International Space Station

FUNCTIONS AND STATISTICS: Dressed for Space

Starts airing: Thursday, May 9, 2002, 11 am ET

Building on past space suit technologies, NASA engineers and researchers use functions and statistics to create the next generation of space suits for the International Space Station and beyond.

Mathematics: functions, statistics

Science: science as inquiry, Earth and space science, physical science, life science, science and technology, science in personal and social perspectives, history and nature of science

NASA Research: Advanced Suit Development, Radiation Analysis

***(R) indicates a repeat show from the 2000-2001 series**

NASA CONNECT INSTRUCTIONAL DESIGN

Each program in the 2001-2002 NASA CONNECT series is designed to enhance and enrich the teaching of specific mathematics, science, and technology concepts. The NASA CONNECT series can be easily integrated into an existing curriculum or used to introduce or reinforce a curriculum topic, objective, or skill. These instructional programs demonstrate the "how to" and the "real world" application and integration of mathematics, science, and technology. NASA CONNECT has two objectives:

1. Students will be able to make connections between the mathematics, science, and technology taught in their classrooms and the real world applications by observing NASA researchers.
2. Students will be able to increase their understanding of mathematics, science, and technology concepts through interactive activities.

Each NASA CONNECT program models an instructional lesson design which includes an anticipatory set, explanation, questioning strategy, and interactive activities. The accompanying lesson guide provides a program summary and objectives, background information, relevant national mathematics, science, and technology standards, step-by-step instructions for conducting the activities, print and on-line resources, and suggestions for extending the activities.

Jackie Chan introduces GEOMETRY AND ALGEBRA: Glow with the Flow.

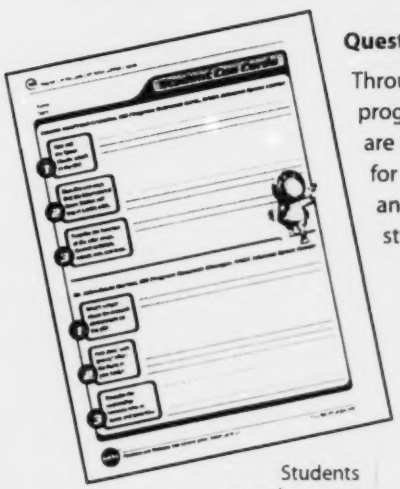
Anticipatory Set

Hosts and celebrity guests focus student attention, connect the program to past,

present, or future learning, and visually and verbally present the learning objectives.

Explanation

NASA engineers, scientists, and other expert guests illustrate the application and relevance of mathematics, science, and technology to the workplace. The connection is further established by introducing students to the tools and methods used by NASA researchers and other experts. Their contributions form the basis for the learning objectives.



Students record answers on Cue Cards.

Questioning strategy

Throughout the program, questions are posed to check for understanding and to give students time to process the mathematics, science, and technology concepts presented. Students record their answers on Cue Cards that are provided in the lesson guide.

Interactive Activities

The hands-on and web activities are based on national mathematics, science, and technology standards. These two interactive activities provide students the opportunity to connect the mathematics, science, and technology concepts learned in the classroom to the research presented by NASA researchers, engineers, and scientists.

NASA CONNECT Teaching Strategy

INTRO TO NASA CONNECT TEACHING STRATEGY

The model proposed to educators through the NASA CONNECT series introduces students to inquiry and the process of searching for patterns and relationships. The six-step teaching strategy is designed to encourage the development of higher order cognitive skills and a more active mental engagement with the television broadcast. Following this strategy enables students to make stronger connections between the television broadcast, the activities, and appropriate mathematics, science, and technology concepts.

The six-step strategy includes reflective discussion, student involvement, dialogue notes, the hands-on activity, journal writing, and the web activity. The strategy, consistent with constructivist theory, promotes rich discourse among students. The proposed format is flexible and effective in enhancing students' understanding of complex mathematics, science, and technology concepts.

STEPS IN NASA CONNECT TEACHING STRATEGY

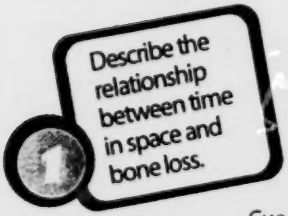
Step 1: Reflective Discussion

Prior to viewing the NASA CONNECT television broadcast or videotaped copy, list and discuss questions and preconceptions that students have about the program topic. Keep these questions on the board during the show. In addition to helping students prepare for the program, these questions can also serve as a pretest for assessment purposes. The following is a sample of teacher-directed questions:

1. What role does mathematics play in science?
2. What kinds of mathematics, science, and technology do NASA experts use in their research?
3. What other skills are necessary to conduct research?
4. Of what value are collaborations and partnerships in conducting research?

Step 2: Student Involvement

NASA CONNECT is not designed for passive viewing and actively engages students throughout the program. The following suggestions are provided to help educators focus student attention on the major concepts presented in the show.



Cue Cards help students stay focused.

Cue Cards have selected questions that focus on the critical elements in each show segment. Educators should copy the Cue Cards from the lesson guide and distribute them prior to viewing the show. Students are encouraged to take notes during the show and answer the questions on the cards.

Norbert's Pause

When viewing a videotaped version of NASA CONNECT, educators have the option to use Norbert's Pause, which gives students an opportunity to reflect, answer, and discuss the Cue Card questions. Norbert, the animated cohost of NASA CONNECT, appears with a remote to indicate an appropriate time to pause the videotape.

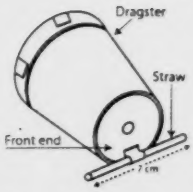
Step 3: Dialogue Notes

Immediately following the show, students should spend five to ten minutes reviewing the questions in "Step 1: Reflective Discussion Section." Educators should ask students to give examples from the show that support their responses to each question.

Review the Cue Cards with students. Educators should ask students to share what they recorded and learned from each guest and NASA researcher. Students should also discuss what they believe are the important mathematics, science, and technology concepts these individuals use in their work.

Step 4: Hands-On Activity

Students learn from direct teaching, engaging in classroom discussion, conducting research, and taking notes. The teacher-tested, hands-on activity is designed to enhance mathematics, science, and technology concepts. Students are assigned to cooperative groups and use everyday objects to complete the activity.



Hands-on activities with step-by-step instructions and diagrams are in every lesson guide.

When using the NASA CONNECT hands-on activity, refer to the lesson guide. Introduce students to the vocabulary, guide students toward connections, explore possible misconceptions associated with the topic, conduct the activity, and conclude by analyzing the data. Finally, have students relate the results of the activity to the NASA research presented in the show.

Step 5: Journal Writing

Journal writing supports students' reflective thinking processes. Students should reflect on what they learned from the show and from their own experimentation. Educators can ask students questions that relate to the application of mathematics, science, and technology concepts presented in the show to real-life situations. Educators might use journal questions to assess student understanding of the concepts presented in the lesson guide.

Step 6: Web Activity

Dan Geroe, NASA CONNECT co-host

Dan's Domain, located on the NASA CONNECT web site, features an interactive web activity for each program that supports and enhances the mathematics, science, and technology content presented in each show. Dan's Domain also provides links to other relevant NASA sites and a Career Corner that features program guests sharing information about their jobs at NASA. Teachers are encouraged to visit the Lab Manager section of Dan's Domain to receive guidance in using the web activities as part of the total NASA CONNECT learning experience (television broadcast/lesson guide/web activity). In the Lab Manager, there is a special link to additional mathematics activities produced by Riverdeep Interactive Learning, a new NASA CONNECT program partner.

The NASA CONNECT web site, **http://connect.larc.nasa.gov**, includes information about the current season and past seasons of NASA CONNECT, broadcast dates and times, and additional student activities. The web site also establishes a connection between the classroom and the family. Educators may send home the NASA CONNECT web address to encourage parents to explore the web activities with their children.

NASA Resources for Educators

NASA's Education Home Page **(http://education.nasa.gov)** serves as the cyber-gateway to information regarding educational programs and services offered by NASA for educators and students across the United States and provides specific details and points of contact for all of NASA's educational efforts and Field Center Offices. Those using the site will have access to a comprehensive overview of NASA's educational programs and services, as well as home pages offered by NASA's four areas of research and development.

NASA Langley Research Center, Office of Education **(http://edu.larc.nasa.gov)** offers a wide variety of opportunities for educators at all levels of instruction. The Office of Education seeks to enhance the teaching of mathematics, science, and technology through its distance learning programs, all of which are described on the web site. Educators can also search NASA educational resources for the classroom, including activities, curriculum enhancing projects, and equipment. From this site, you can link to our NASA CONNECT web site.

NASA Spacelink **(http://spacelink.nasa.gov)** is one of NASA's electronic resources that is specifically developed for use by the education community. This comprehensive electronic library offers teacher guides, wall sheets, listings of videos, computer software, and other materials that have been developed to meet national education standards. Educators can search specific curriculum materials by grade level and subject matter. Current and historical information related to NASA's aeronautic and space research can be found on Spacelink. Links to NASA Educator Resource Centers (ERCs), the Central Operations of Resources for Educators (CORE), news releases, current state reports on agency projects and events, and television broadcast schedules for NASA Television are also provided.

Quest **(http://quest.nasa.gov)** is the home of NASA's K-12 internet initiative. This electronic resource specializes in providing programs, materials, and opportunities for teachers and students to use NASA resources as learning tools to explore the Internet. One of its unique projects is Sharing NASA, a series about on-line, interactive units where students can communicate with NASA scientists and researchers to experience the excitement of real science in real time.

The Learning Technologies Channel (LTC) **(http://quest.nasa.gov/ltc/)** is a NASA location on the Internet that allows you to participate in on-line courses and to remotely attend some NASA workshops and seminars. A primary focus of the LTC is to broaden the uses of the Internet to include in-service teacher training and to bring new internet experiences into the classroom.

NASAexplores **(http://NASAexplores.com/)** provides science, mathematics, and technology lessons that are published weekly. NASAexplores gives teachers timely educational content based on current research, development, and related events. The web site provides an e-mail subscriber list service to notify subscribers of weekly content. Teachers sign up to receive e-mail notices linking them directly to the web site where the lessons, along with related resources and materials, are posted. Teachers without e-mail can also access the lessons by visiting the NASAexplores web site.

NASA CORE, Central Operation of Resources for Educators **(http://core.nasa.gov)** is a worldwide distribution center for NASA multimedia educational materials. Educational materials include videotape programs, slide sets, and computer software. For a minimal fee, NASA CORE will provide educators with materials through its mail order service. A free NASA CORE catalog is available.

NASA CORE
15181 State Route 58 South, Oberlin, OH 44074,
phone: (440) 775-1400, fax: (440) 775-1460,
E-mail: nasaco@leeca.org

EDUCATOR RESOURCE CENTER NETWORK

The NASA Educator Resource Center Network (ERCN) is composed of Educator Resource Centers (ERCs) located on or near all NASA field centers, colleges, museums, or other nonprofit organizations. These centers provide educators with inservice and preservice training, demonstrations, and access to NASA instructional products.

For a list of ERCs in your state, visit the NASA Educator Resource Center Network, **http://education.nasa.gov/ercn**. Educators may also contact one of the ERCs at the following NASA Centers.

AK, Northern CA (southern-most counties of Inyo, Kings, Monterey, Tulare), HI, ID, MT, NV, OR, UT, WA, WY
NASA Ames Educator Resource Center
Mail Stop 253-2
Moffett Field, CA 94035-1000
(650) 604-3574
http://amesnews.arc.nasa.gov/erc/erchome.html

AZ, Southern CA (northern-most counties of Kern, San Bernadino, San Luis Obispo)
NASA Dryden Educator Resource Center
45108 North Third Street East
Lancaster, CA 93535
(661) 948-7347
http://www.dfrc.nasa.gov/trc/ERC

CA
NASA JPL Educator Resource Center
Village at Indian Hills Mall
1460 East Holt Blvd., Suite 20
Pomona, CA 91767
(909) 397-4420
http://eis.jpl.nasa.gov/eao/

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT
NASA Goddard Educator Resource Center
Mail Code 130.3
Greenbelt, MD 20771
(301) 286-8570
http://pao.gsfc.nasa.gov/gsfc/educ/trl/welcome.html

VA's and MD's Eastern Shore
NASA Wallops Educator Resource Center
Education Complex - Visitor Center
Building J-17
Wallops Island, VA 23337
(757) 824-2298
http://www.wff.nasa.gov/pages/visitor.html

FL, GA, Puerto Rico, Virgin Islands
NASA Kennedy Educator Resource Center
Mail Code ERC
J.F. Kennedy Space Center, FL 32899
(321) 867-4090
http://www-pao.ksc.nasa.gov/kscpao/educate/edu.htm

CO, KS, NE, NM, ND, OK, SD, TX
Johnson Space Center
1601 NASA Road One
Houston, TX 77058
(281) 244-2129
http://www.spacecenter.org/educator_resource.html

KY, NC, SC, VA, WV
NASA Langley Educator Resource Center
Virginia Air and Space Center
600 Settlers Landing Road
Hampton, VA 23669
(757) 727-0900, ext. 757
http://www.vasc.org/erc

IL, IN, MI, MN, OH, WI
NASA Glenn Educator Resource Center
21000 Brookpark Road, MS 8-1
Cleveland, OH 44135
(216) 433-2017
http://www.grc.nasa.gov/WWW/PAO/html/edteachr.htm

AL, AR, IA, LA, MO, TN
NASA Marshall Educator Resource Center
U.S. Space and Rocket Center
One Tranquility Base
Huntsville, AL 35807
(256) 544-5812
http://erc.msfc.nasa.gov

MS
NASA Stennis Educator Resource Center
Building 1200
Stennis Space Center, MS 39529
(228) 688-3338
http://education.ssc.nasa.gov/htmls/trc/trc.htm

Off-air rights are granted in perpetuity. Educators are granted unlimited rights of duplication, dubbing, broadcasting, cable casting, and web casting into perpetuity, with the understanding that all NASA CONNECT materials will be used for educational purposes. Neither the broadcast, the lesson guides, nor the web activities may be used, either in whole or in part, for commercial purposes without the expressed written consent of NASA CONNECT.

2000-2001 NASA CONNECT SERIES OVERVIEW

INTRODUCTION TO THE NASA CONNECT SERIES

NASA CONNECT is a series of 30-minute, instructional video programs for students in grades 5-8. Produced by the NASA Langley Research Center's Office of Education in Hampton, Virginia, the programs can be viewed live or taped for later use. NASA CONNECT is broadcast via Ku- and C-band satellite (television) and is web cast via the Internet through NASA's Learning Technology Channel. Many PBS-affiliated stations across the country carry NASA CONNECT. By using a steerable dish, the program can also be downlinked using the satellite coordinates posted on the NASA CONNECT web site.

Endorsed by the National Council of Teachers of Mathematics (NCTM), NASA CONNECT supports the national mathematics, science, and technology standards. Each NASA CONNECT program seeks to establish a "connection" between the mathematics, science, and technology concepts taught in the classroom and the mathematics, science, and technology used everyday by NASA researchers. By demonstrating the processes of creativity, critical thinking, and problem solving skills, NASA CONNECT enhances and enriches mathematics, science, and technology education.

The NASA CONNECT series can be easily integrated into an existing curriculum or used to introduce or reinforce a curriculum topic, objective, or skill. This introductory packet includes a six-step teaching protocol for the educator. Each NASA CONNECT program is accompanied by a lesson guide describing a hands-on classroom activity and web-based activity which complement and extend the lesson.

The American Institute of Aeronautic and Astronautics (AIAA) has agreed to provide classroom mentors to assist teachers with the student activities. Every effort will be made to match a teacher with an AIAA member who will assist the teacher either in person or by e-mail. To request a mentor, e-mail **nasaconnect@aiaa.org** or call Lisa Bacon at (703) 264-7527 at least four weeks prior to conducting the student activity.

AIAA FOUNDATION

Contact the AIAA to get a classroom mentor.

NASA CONNECT is FREE to educators. Register for NASA CONNECT on our web site **(http://connect.larc.nasa.gov)** or by phone (757-864-6100). Registered educators will receive, via e-mail, the date of upcoming shows, a show summary, and the lesson guide. NASA CONNECT is a U.S. Government product and is not subject to copyright. There are no fees or licensing agreements.

THE 2000-2001 NASA CONNECT SERIES

Endorsed by the National Council of Teachers of Mathematics (NCTM), the 2000-2001 NASA CONNECT series uses proportional reasoning as the "integrative thread" that "connects" mathematics topics in each program.

The 2000-2001 NASA CONNECT series uses aeronautics and space technology (A-ST) as its organizing theme. This theme forms the creative basis for a series of five programs that demonstrate the problem-solving focus of NASA A-ST research. NASA A-ST goals are grouped into three areas or "Three Pillars": Global Civil Aviation, Revolutionary Technology Leaps, and Access to Space. These three pillars reflect national priorities for the NASA Aero-Space Technology Enterprise and require taking risks and performing the long-term research and development programs needed to keep the United States the global leader in aeronautics and space exploration.

THE 2000-2001 NASA CONNECT PROGRAMS

MEASUREMENT, RATIOS, AND GRAPHING: 3, 2, 1...Crash!
Thursday, October 19, 2000, 11:00 - 11:30 AM (EDT)
Crashing planes, skidding tires, and blasting water, NASA researchers work to improve airplane performance and safety.
Mathematics: measurement, ratios, graphing
Science: science and technology, science as inquiry, physical science
Technology: productivity tools, communication tools, research tools
NASA Research: Aircraft Landing Dynamics Facility (ALDF), Impact Dynamics Research Facility (IDRF)

GEOMETRY AND ALGEBRA: Glow with the Flow
Thursday, November 16, 2000, 11:00 - 11:30 AM (EST)
NASA aerospace researchers use models to see how air flows and why materials glow under wind tunnel conditions.
Mathematics: geometry, algebra
Science: physical science, science and technology, science in personal and social perspectives, science as inquiry
Technology: productivity tools, communication tools, research tools
NASA Research: Flow Visualization and Blended Wing Body (BWB)

PATTERNS, FUNCTIONS, AND ALGEBRA: Wired for Space
Thursday, February 15, 2001, 11:00 - 11:30 AM (EST)
NASA researchers develop new ways to propel a spacecraft already in orbit without the aid of fuel.
Mathematics: patterns, functions, algebra
Science: physical science, Earth and space science, science as inquiry
Technology: productivity tools, communication tools, research tools
NASA Research: Propulsive Small Expendable Deployer System (ProSEDS)

DATA ANALYSIS AND MEASUREMENT: Ahead, Above the Clouds
Thursday, March 15, 2001, 11:00 - 11:30 AM (EST)
Predicting severe weather, tracking clouds, and monitoring pollutants in the air, NASA scientists develop technologies to better understand our planet.
Mathematics: data analysis, measurement
Science: Earth and space science, physical science, science as inquiry, science and technology, science in personal and social perspectives
Technology: productivity tools, communication tools, research tools
NASA Research: Geostationary Imaging Fourier Transform Spectrometer (GIFTS)

FUNCTIONS AND STATISTICS: International Space Station (ISS): Up to Us
Thursday, April 19, 2001, 11:00 - 11:30 AM (EST)
Ground research + space research = true science as international researchers anticipate working together onboard the ISS.
Mathematics: functions, statistics
Science: science and technology, Earth and space science, physical science, science as inquiry
Technology: productivity tools, communication tools, research tools
NASA Research: ISS

NASA CONNECT INSTRUCTIONAL PROGRAM

Each program in the 2000-2001 NASA CONNECT series is designed to enhance and enrich the teaching of specific mathematics, science, and technology concepts. These programs are instructional in that they demonstrate the "how to" and the "real world" application and integration of mathematics, science, and technology. The NASA CONNECT instructional program has two objectives.

1. Students will be able to make connections between the mathematics, science, and technology taught in their classrooms and the real world applications by observing NASA researchers.

2. Students will be able to increase their understanding of mathematics, science, and technology concepts through interactive activities.

Each NASA CONNECT program models an instructional lesson design which includes an anticipatory set, explanation, questioning strategy, and interactive activities. Each NASA CONNECT program is supported by a lesson guide that provides a program summary and objectives, background information, relevant national mathematics, science, and technology standards, step-by-step instructions for conducting the activities, print and on-line resources, and suggestions for extending the activities.

ANTICIPATORY SET

Hosts and celebrity guests focus student attention, connect the program to past, present, or future learning, and visually and verbally present the learning objectives.

EXPLANATION

NASA engineers, scientists, and other expert guests illustrate the application and relevance of mathematics, science, and technology to the workplace. The connection is further established by introducing students to the tools and methods used by NASA researchers and other experts. Their contributions form the basis for the learning objectives.

QUESTIONING STRATEGY

Throughout the program, questions are posed to check for understanding and to give students time to process the mathematics, science, and technology concepts presented. Students record their answers on cue cards that are provided.

INTERACTIVE ACTIVITIES

The classroom and web-based activities are based on the national mathematics, science, and technology standards. These two interactive activities provide students the opportunity to connect the mathematics, science, and technology concepts learned in the classroom to the research presented by NASA engineers and scientists.

NASA CONNECT TEACHING PROTOCOL

INTRO TO NASA CONNECT TEACHING PROTOCOL

The model proposed to educators through the NASA CONNECT series introduces students to inquiry and the process of searching for patterns and relationships. The six-step teaching protocol below is designed to encourage the development of higher order cognitive skills and a more active mental engagement with the video program. Following this protocol enables students to make stronger connections between the NASA CONNECT program, the activities, and appropriate mathematics, science, and technology concepts.

The six-step protocol includes reflective discussion, student involvement, dialogue notes, the NASA CONNECT activity, journal writing, and the NASA CONNECT web site. The protocol, consistent with constructivist theory, promotes rich discourse among students. The proposed format is flexible and effective in enhancing students' understanding of complex mathematics, science, and technology concepts.

STEPS IN NASA CONNECT TEACHING PROTOCOL

STEP 1: REFLECTIVE DISCUSSION

Prior to viewing the NASA CONNECT program, list and discuss questions and preconceptions that students have about the program topic. Keep these questions on the board during the video. In addition to helping students prepare for the program, these questions can also serve as a pretest for assessment purposes. The following is a sample of teacher-directed questions:

1. What role does mathematics play in science?
2. What kinds of mathematics, science, and technology do NASA experts use in their research?
3. What other skills are necessary to conduct research?
4. Of what value are collaborations and partnerships in conducting research?

STEP 2: STUDENT INVOLVEMENT

NASA CONNECT is not designed for passive viewing. NASA CONNECT actively engages students throughout the program. The following suggestions are provided to help teachers focus student attention on the major concepts presented in the video.

Cue Cards

Cue Cards have selected questions that focus on the critical elements in each video segment. Teachers should copy the Cue Cards from the lesson guide and distribute them prior to viewing the video. Students are encouraged to take notes during the video and answer the questions on the cards. In addition, educators may want to use Norbert's pause.

Norbert's Pause

If students view a videotaped version of NASA CONNECT, educators have the option to pause the videotape. Norbert, the animated cohost of NASA CONNECT, appears with a remote to indicate an appropriate time to pause the videotape. The pause creates an opportunity for student reflection and discussion.

STEP 3: DIALOGUE NOTES

Immediately following the video, students should spend five to ten minutes reviewing the questions in "Step 1: Reflective Discussion Section." Teachers should ask students to give examples from the video presentation that support their responses to each question.

Review the Cue Cards with students. Teachers should ask students to share what they recorded and learned from each guest and NASA researcher. Students should also discuss what they believe are the important mathematics, science, and technology concepts these individuals use in their work.

STEP 4: NASA CONNECT ACTIVITY

Students learn from direct teaching, engaging in classroom discussion, conducting research, and taking notes. The teacher-tested classroom activity is designed to enhance mathematics and science concepts. Students are assigned to cooperative groups and use everyday objects to complete the activity.

When using the NASA CONNECT classroom activity, refer to the lesson guide. Introduce students to the vocabulary, guide students toward connections, explore possible misconceptions associated with the topic, conduct the activity, and conclude by analyzing the data. Finally, have students relate the results of the activity to the NASA research presented in the video.

STEP 5: JOURNAL WRITING

Journal writing supports students' reflective thinking processes. Students should reflect on what they learned from the video and from their own experimentation. Educators can ask students questions that relate to the application of mathematics, science, and technology concepts presented in the video to real-life situations. Educators might use journal questions to assess student understanding of the concepts presented in the lesson guide.

STEP 6: NASA CONNECT WEB

The web site uses the inquisitory instruction strategy to place students in a contextual environment and encourages them to understand the mathematics, science, and technology concepts and skills presented in the program. The web site also presents multiple perspectives to specific questions raised in the video. A series of activities is incorporated into the NASA CONNECT web site for each program to augment the video theme and to provide additional opportunities for students to perform multiple trials and share their data with others. Teachers might use this site to establish a connection between the classroom and the family by sending home a notice about the NASA CONNECT program and its Internet URL and by encouraging parents to explore this site and complete the activities with their children.

NASA RESOURCES FOR EDUCATORS

NASA Langley Research Center, Office of Education **(http://edu.larc.nasa.gov)** offers a wide variety of opportunities for educators at all levels of instruction. The Office of Education seeks to enhance the teaching of mathematics, science, and technology through its distance learning programs, all of which are described on the web site. Educators can also search NASA educational resources for the classroom including activities, curriculum enhancing projects, and equipment. From this site, you can link to our NASA CONNECT web site.

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NASA CORE
15181 State Route 58 South, Oberlin, OH 44074,
phone: (440) 775-1400, fax: (440) 775-1460, E-mail: nasaco@leeca.org

EDUCATOR RESOURCE CENTERS (ERCs)

The NASA Educator Resource Centers' Network is composed of Educator Resource Centers located at or near all NASA installations. ERCs are located at planetariums, universities, museums, and other nonprofit organizations nationwide. These centers supply instructional activities, videotapes, slides, and computer software generated by NASA programs, technologies, and discoveries. These materials are designed for educators of all disciplines and are aligned to the national education standards.

For more information on NASA education programs and aeronautics-related materials, educators may contact the ERC at the following NASA Centers. The NASA field centers that have leading roles and responsibilities in Aero-Space Technology (A-ST) research are in **boldface**.

AK, AZ, CA, HI, ID, MT, NV, OR, UT, WA, WY
NASA Ames Educator Resource Center
Mail Stop 253-2
Moffett Field, CA 94035-1000
(650) 604-3574

CA cities near the center
NASA Dryden Educator Resource Center
45108 North Third Street East
Lancaster, CA 93535
(661) 948-7347

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT
NASA Goddard Educator Resource Center
Mail Code 130.3
Greenbelt, MD 20771
(301) 286-8570

CO, KS, NE, NM, ND, OK, SD, TX
Johnson Space Center
1601 NASA Road One
Houston, TX 77058
(281) 244-2129

CA cities near the center
NASA JPL Educator Resource Center
Village at Indian Hills Mall
1460 East Holt Blvd., Suite 20
Pomona, CA 91767
(909) 397-4420

FL, GA, PR, VI
NASA Kennedy Educator Resource Center
Mail Code ERC
J.F. Kennedy Space Center, FL 32899
(407) 867-4090

KY, NC, SC, VA, WV
NASA Langley Educator Resource Center
Virginia Air and Space Center
600 Settlers Landing Road
Hampton, VA 23669
(757) 727-0900, ext. 757

IL, IN, MI, MN, OH, WI
NASA Glenn Educator Resource Center
21000 Brookpark Road, MS 8-1
Cleveland, OH 44135
(216) 433-2017

AL, AR, IA, LA, MO, TN
NASA Marshall Educator Resource Center
U.S. Space and Rocket Center
One Tranquility Base
Huntsville, AL 35758
(256) 544-5812

MS
NASA Stennis Educator Resource Center
Building 1200
Stennis Space Center, MS 39529
(228) 688-3220

VA's and MD's Eastern Shore
NASA Wallops Educator Resource Center
Education Complex - Visitor Center
Building J-17
Wallops Island, VA 23337
(757) 824-2298

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